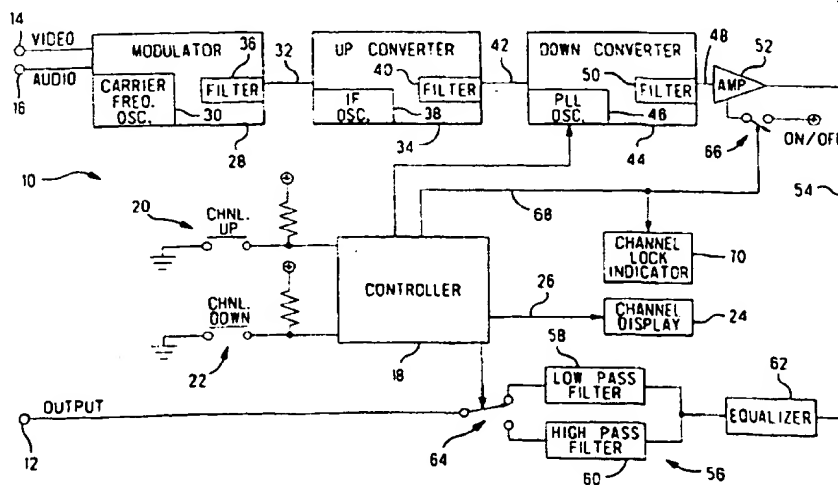




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(54) Title: FREQUENCY AGILE MODULATOR



(57) Abstract

A frequency agile modulator which modulates input baseband video and audio signals to a selected NTSC channel. The modulator includes a microprocessor which has as inputs a channel up push-button switch and a channel down push-button switch. An amplifier stage of the modulator is turned off by the microprocessor when the channel is being changed. A low pass noise limiting filter and a high pass noise limiting filter are connected in parallel between the amplifier stage output and the output of the modulator and, depending upon the selected channel, either one or the other of the filters is inserted in the signal path by the microprocessor. Equalizer circuitry is provided at the output of the modulator so that lower frequency signals are transmitted at a lower level than higher frequency signals.

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FREQUENCY AGILE MODULATOR

This invention relates to modulators for television signals and, more particularly, to a frequency agile
5 modulator controllable to modulate input baseband video and audio signals to a selected defined television channel.

It is proposed to provide a wideband signal distribution system for distributing among a plurality
10 of outlets wideband signals modulated onto RF carrier signals within a specified frequency band. A particular application of such a system is the distribution of television programs within a school, which may have a number of classrooms and administrative offices, each
15 having a television monitor. At a given time, it may be desired to provide a television program to selected ones of the classrooms and offices, originating either from a source within one of the classrooms or offices, such as a VCR or video camera, or from an outside source, such
20 as a local cable system. Each of the classrooms and offices is therefore provided with an outlet having an input port and an output port and, when a program originating in a particular office or classroom is to be distributed, the source is connected to the input port
25 of the outlet in that particular room. Since several programs may be distributed throughout the school at a given time, each program must be assigned to a specific and unique television channel so that there is no interference therebetween. It is therefore an object of
30 the present invention to provide a frequency agile modulator by means of which baseband video and audio signals may be modulated onto a selected television channel.

It is a further object of the present invention to
35 provide such a frequency agile modulator which can be easily operated by a user not having any technical training.

It is another object of the present invention to provide such a frequency agile modulator which prevents potentially interfering signals from being transmitted when the channel is being changed to a selected channel.

5 The foregoing and additional objects are attained in accordance with the principles of this invention by providing a frequency agile modulator which provides at an output terminal a modulated signal in a selected frequency band corresponding to a defined television
10 channel. A modulator stage receives input baseband video and audio signals and modulates a carrier signal with the input baseband video and audio signals to provide a modulated carrier signal. An up converter stage mixes the modulated carrier signal with a fixed
15 frequency oscillation signal to provide a modulated intermediate frequency signal, and a down converter stage including a controllable variable frequency oscillator mixes the modulated intermediate frequency signal with the output of the variable frequency
20 oscillator to provide a modulated radio frequency signal in a selected frequency band corresponding to a defined television channel. The modulator also includes a transmission path coupled between the down converter stage and the modulator output terminal, with the
25 transmission path being selectively switchable to an off state wherein the modulated radio frequency signal is prevented from passing therethrough. The modulator further includes a selector by means of which a user can identify a selected television channel, and a controller
30 coupled to the selector for controlling the variable frequency oscillator and the transmission means. The controller is effective in response to the selector changing its identification of a selected television channel for changing the frequency of the variable
35 frequency oscillator to correspond to the newly selected television channel and for causing the transmission path

to switch to its off state for a predetermined period of time.

In accordance with an aspect of this invention, the selector includes a first user influenced switch which is selectively actuatable for indicating that the selected television channel is to be incremented and a second user influenced switch which is selectively actuatable for indicating that the selected television channel is to be decremented.

In accordance with another aspect of this invention, the modulator further includes a low pass filter and a high pass filter, each coupled between the output of the transmission means and the output terminal, and switch coupled to the filters for causing only a selected one of the filters to be in the circuit path between the output of the transmission means and the output terminal. The controller controls the switch in accordance with the selected television channel.

The invention will now be described by way of example with reference to the accompanying figure which is a block diagram of a frequency agile modulator constructed in accordance with the principles of this invention.

The drawing shows a frequency agile modulator, designated generally by the reference numeral 10, constructed in accordance with the principles of this invention which is operative for providing at its output terminal 12 a modulated signal in a selected frequency band corresponding to a defined television channel. These television channels, and their corresponding frequency bands, are in accordance with a standard specified by the National Television System Committee (NTSC), as is well known in the art. The input terminals 14 and 16 receive the input baseband video and audio signals, respectively, which are to be so modulated. These baseband signals may originate, for example, from a VCR or television camera, or may be

demodulated television program signals received from a local cable company or other source which are to be remodulated to a selected channel.

Operation of the modulator 10 is under the control of the controller 18, which is preferably a programmed microprocessor. Inputs to the controller 18 include a channel selector having a user influenced "channel up" push-button switch 20 and a user influenced "channel down" push-button switch 22. These two switches 20, 22 comprise the sole means by which the user can control the modulator 10, other than by applying power thereto, so that such control does not require a technical background. To assist the user, a channel display 24 is provided, which is under the control of the controller. Illustratively, the channel display 24 comprises a two place seven segment light emitting diode display which responds to signals provided by the controller 18 over the leads 26 for displaying a visual representation, in alphanumeric form, of the selected television channel. In operation, the user actuates the switches 20, 22 to step through the available channels, as shown on the display 24. Upon reaching the desired channel, the user merely ceases actuation of the switches 20, 22. As will be described hereinafter, the controller 18 senses lack of actuation of the switches 20, 22 for a predetermined period of time as an indication that the desired channel has been selected.

The input baseband video and audio signals received at the input terminals 14 and 16, respectively, are applied as inputs to the modulator stage 28 which includes a carrier frequency oscillator 30. As is conventional, the oscillator 30 provides a carrier signal at a frequency of 45.75 MHz and the baseband video and audio signals are used to modulate this carrier signal. The modulated carrier signal is then provided as an output on the lead 32 to the up converter stage 34 after passing through the bandpass filter 36

which insures that the modulated signal on the output lead 32 is a single vestigial signal.

The up converter stage 34 mixes the modulated carrier signal on the lead 32 with a fixed intermediate frequency signal from the oscillator 38, which preferably has a frequency of 200 MHz, to provide a modulated intermediate frequency signal. This signal is passed through the filter 40, which preferably is a bandpass filter centered at 245.75 MHz. The output of the up converter stage 34 on the lead 42 is provided as an input to the down converter stage 44.

The function of the down converter stage 44 is to shift the frequency band of the signal on the lead 42 into the frequency band of the television channel selected by the user via the switches 20, 22 and displayed on the display 24. These frequency bands and the alphanumeric representations thereof are standards set by the NTSC. Accordingly, the down converter stage 44 includes a controllable variable frequency oscillator 46, preferably a phase locked loop oscillator, controllable by the controller 18 to provide an oscillation signal which is mixed with the modulated intermediate frequency signal on the lead 42 to provide a modulated radio frequency signal in the selected frequency band corresponding to the selected television channel. This signal is passed to the output lead 48 through the filter 50, which is preferably a low pass filter to eliminate high frequency out of band spurious noise signals.

Since the distribution system may have different television programs being distributed thereover at the same time, it is apparent that there must be a system for assigning channels to the various users. In addition, it would be advantageous to insure that when a user is selecting a channel by means of the switches 20, 22, interfering signals are not transmitted in a channel that is already in use. Thus, for example, a first user

may be transmitting a program on channel 4 and a second user may wish to transmit a program on channel 6. When the second user turns on the modulator 10 it will initialize to channel "00". Then, by manipulating the channel up push-button switch 20, the second user will cause the channel setting of the modulator 10 to pass through channel 4 before coming to channel 6. According to the present invention, no signals are applied to the output terminal 12 until the modulator 10 has been set to a selected channel for a predetermined period of time. This is accomplished by providing an amplifier stage 52 which is controlled by the controller 18 to block signal transmission therethrough for a predetermined period of time after each operation of the channel up selector switch 20 or the channel down selector switch 22, as will be described in full detail hereinafter. The normal function of the amplifier stage 52 is to amplify the signal to overcome losses in the distribution network.

The amplified signal on the lead 54 passes to the filter stage 56 which includes the low pass filter 58 and the high pass filter 60. The filters 58, 60 are coupled between the output of the amplifier stage 52 and the output terminal 12, through the equalizer 62. Connected between the outputs of the filters 58, 60 and the output terminal 12 is a switch 64 which is controlled by the controller 18 so that only one of the filters 58, 60 is connected in the signal path at any given time. The selected filter is chosen in accordance with the selected channel. If a low frequency channel is selected, then the low pass filter 58 is in the signal path. Conversely, if a high frequency channel is selected, then the high pass filter 60 is in the signal path. The purpose of the filters 58, 60 is for noise limiting.

It is known that higher frequency signals are subject to greater attenuation by the transmission

medium than lower frequency signals. Accordingly, the equalizer 62 is provided. The equalizer 62 is a frequency dependent attenuator which attenuates the signal passing therethrough as a monotonically decreasing function of the signal frequency. Thus, high frequency signals are attenuated less than low frequency signals. In other words, the lower frequency signals are transmitted at a lower level than the higher frequency signals. Accordingly, once the overall gain of the modulator 10 is set, the power level of the signal received at an outlet is substantially frequency independent.

As previously discussed, the modulator 10 according to the present invention is arranged to block signal transmission during channel changing. As shown, the controller 18 causes the amplifier stage 52 to selectively block transmission therethrough by means of the switch 66 which controls the application of power to the amplifier stage 52. Thus, when the switch 66 is open, the amplifier stage 52 is unpowered and signals cannot pass therethrough. When the controller 18 determines that the user has selected a desired channel due to there being no actuation of the switches 20, 22 for a predetermined period of time, a channel lock signal is transmitted on the lead 68. This channel lock signal causes the switch 66 to close and provide power to the amplifier stage 52, allowing the modulated signal to appear on the output terminal 12. At the same time, the channel lock signal is received by the channel lock indicator 70, which illustratively includes a light emitting diode which is then energized to inform the user that the channel number shown on the display 24 has been selected and is being used for distributing the program provided at the input terminals 14, 16. When the light emitting diode is not energized, this indicates that there is no transmission by the modulator 10.

Accordingly, there has been disclosed an improved frequency agile modulator. While an illustrative embodiment of the present invention has been disclosed herein, it is understood that various modifications and adaptations to the disclosed embodiment will be apparent to those of ordinary skill in the art and it is intended that this invention be limited only by the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A frequency agile modulator for providing at an output terminal a modulated signal in a selected frequency band corresponding to a defined television channel, the modulator having an input for receiving input baseband video and audio signals and a selector for identifying a selected television channel; characterized by:

an up converter for mixing said modulated carrier signal with a fixed frequency oscillation signal to provide a modulated intermediate frequency signal;

a down converter including a controllable variable frequency oscillator for mixing said modulated intermediate frequency signal with the output of said variable frequency oscillator to provide a modulated radio frequency signal in a selected frequency band corresponding to a defined television channel;

a transmission path coupled between said down converter and said output terminal, said transmission path being selectively switchable to an off state wherein said modulated radio frequency signal is prevented from passing therethrough; and

a controller coupled to said selector for controlling said variable frequency oscillator and said transmission path;

wherein said controller is effective in response to said selector changing an identification of a selected television channel for changing the frequency of said variable frequency oscillator to correspond to the newly selected television channel and for causing said transmission path to switch to its off state for a predetermined period of time.

2. The modulator according to Claim 1 wherein said variable frequency oscillator includes a phase locked loop.

3. The modulator according to Claim 1 wherein said selector includes a first user influenced switch which is selectively actuatable for indicating that the selected television channel is to be incremented and a second user influenced switch which is selectively actuatable for indicating that the selected television channel is to be decremented.

4. The modulator according to Claim 3 wherein: said controller is further effective for generating a channel lock signal when neither of said first and second user influenced switches has been actuated for said predetermined period of time; and

said transmission path includes an amplifier and a switch coupled to a source of power for said amplifier, said switch being responsive to said channel lock signal for applying power to said amplifier.

5. The modulator according to Claim 4 further including:

an indicator including a selectively energizable visual indicator, said indicator being coupled to receive said channel lock signal from said controller and responsive to said received channel lock signal for energizing said visual indicator.

6. The modulator according to Claim 1 wherein said controller includes a programmed microprocessor.

7. The modulator according to Claim 1 further including:

a low pass filter coupled between the output of said transmission path and said output terminal;

a high pass filter coupled between the output of said transmission path and said output terminal; and

a switch coupled to said filters for causing only a selected one of said filters to be in the circuit path between the output of said transmission path and said output terminal;

5 wherein said controller is further effective to control said switch in accordance with the selected television channel.

8. The modulator according to Claim 1 further
10 including:

an equalizer coupled between the output of said transmission path and said output terminal for attenuating the modulated radio frequency signal as a monotonically decreasing function of the signal
15 frequency.

9. The modulator according to Claim 1 wherein said controller is further effective for generating a display signal representative of the selected television
20 channel, the modulator further including:

a display coupled to receive said display signal from said controller and responsive to said received display signal for displaying a visual representation of the selected television channel.

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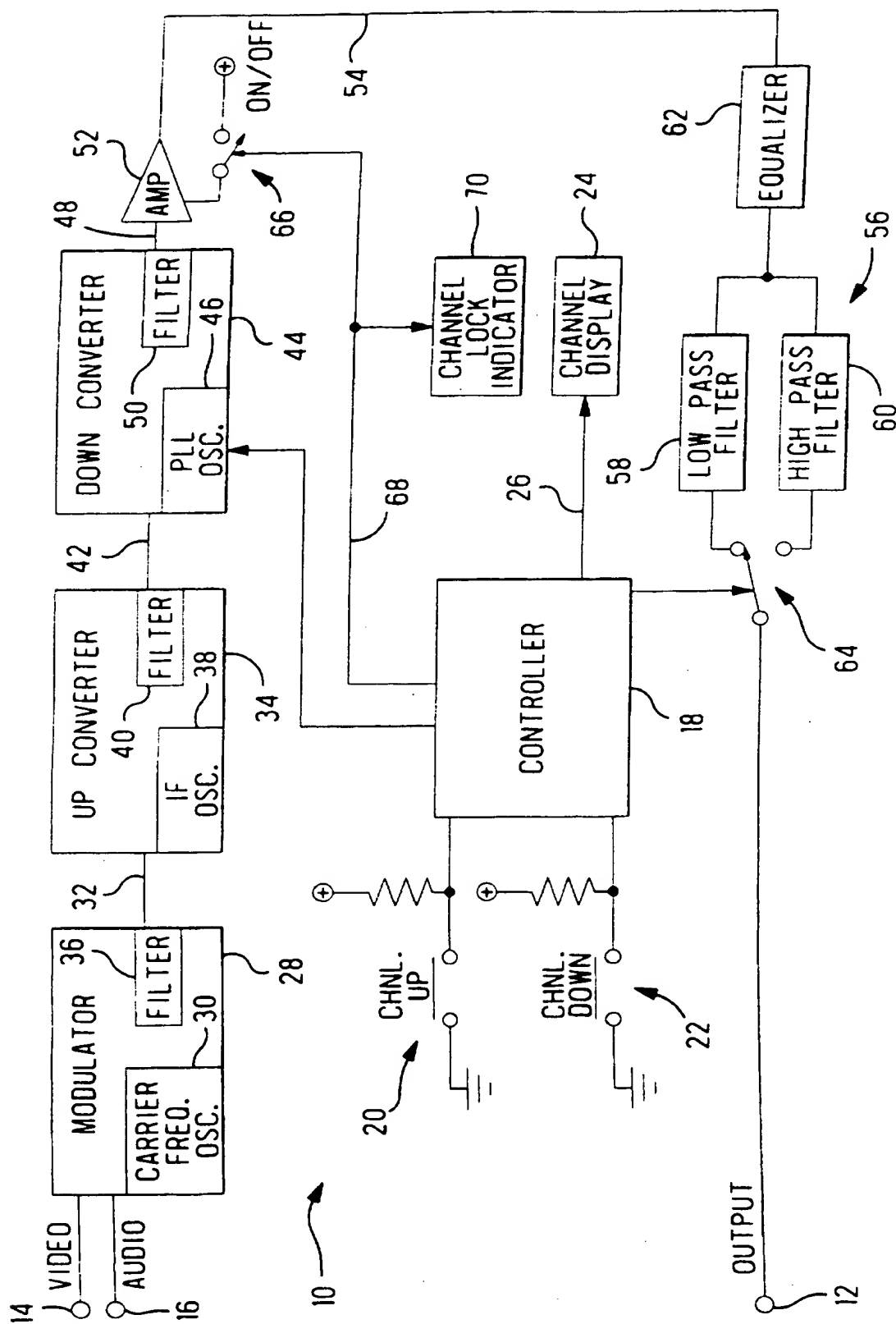
10. The modulator according to Claim 1 wherein said controller is further effective for generating a channel lock signal when said transmission path is switched out of its off state, the modulator further including:

an indicator including a selectively energizable visual indicator, said indicator being coupled to receive said channel lock signal from said controller and responsive to said received channel lock signal for energizing said visual indicator.

11. The modulator according to Claim 1 wherein said transmission path includes an amplifier.

12. The modulator according to Claim 11 wherein said controller is effective to selectively remove power from said amplifier so as to cause said transmission path to switch to its off state.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 96/19989

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H03D7/16 H04N7/10 H03J1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H03D H04J H04N H03J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 038 404 A (MARZ DANIEL) 6 August 1991 see column 1, line 1 - column 5, line 53; figure 2A ---	1
A	US 4 527 194 A (SIRAZI SEMIR) 2 July 1985 see column 2, line 41 - column 5, line 17; figure 1 ---	1
A	EP 0 582 023 A (FRITZ FISCHER ELEKTRONIK) 9 February 1994 -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Initial Application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5038404 A	06-08-91	NONE	
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